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THE ACADEMIC PREPARATION AND BACKGROUND OF PUBLIC SECONDARY  
MATHEMATICS TEACHERS IN UTAH 1966-1967

by

Charles Martin Crittenden

A thesis submitted in partial fulfillment  
of the requirements for the degree  
of  
MASTER OF SCIENCE  
in  
Secondary Education (Mathematics)

Approved:

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Major Professor

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UTAH STATE UNIVERSITY  
Logan, Utah  
1968

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A special thanks to my wife, Gloria, for her unending encouragement, understanding, and love; and for four beautiful children: Herbert, Charlene, Lillie Ann, and Kristanne.

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## ABSTRACT

The Academic Preparation and Background of Public Secondary  
Mathematics Teachers in Utah 1966-1967

by

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Utah State University, 1967

Major Professor: Dr. Ross R. Allen  
Department: Secondary Education

A random survey was conducted to determine the academic preparation and background of the public secondary mathematics teachers in the state of Utah.

The survey indicated that there is a wide variance in the teacher mathematics preparation between the three types of public secondary schools. The class B high schools have a smaller percentage of well prepared mathematics teachers than either the class A high schools or the junior high schools.

The following facts were discovered: (1) 22.03 percent of all the surveyed mathematics teachers had between 1 and 15 quarter hours of college mathematics preparation, (2) 5.22 percent had 0 quarter hours of mathematics preparation, (3) 33.33 percent of all the surveyed teachers had 45 or more quarter hours of mathematics preparation, (4) 53.33 percent had completed one year of calculus, (5) 68.41 percent had some formal training in "modern" mathematics, and (6) 43.77 percent had participated in some type of National Science Foundation mathematics institute.



## STATEMENT OF THESIS PROBLEM

With the rapidly increasing advancements in the technological fields, there is an increasing demand for better trained and more qualified people. There has also been a great movement to find better teaching methods, materials, and curricula. The following are examples: programmed materials, television, team teaching, and the united effort of secondary school teachers, college professors, and practicing professional people to develop better curricula. Their efforts have produced such programs as the University of Illinois Commission of School Mathematics (UICSM), School Mathematics Study Group (MSG), The Greater Cleveland Mathematics Project, University of Maryland Mathematics Project, Ball State Teachers College Experimental Program, as well as many similar programs in chemistry, physics, and the biological sciences.

The United States Government has shown a direct interest in these programs and in 1953 instituted the National Science Foundation (NSF). Through the NSF, both secondary and college teachers can obtain scholarships to return to the universities and obtain further training in their fields, and also become acquainted with the new teaching materials and techniques.

All of the above mentioned programs are a direct effort to better prepare today's teachers and, in turn, better prepare today's and tomorrow's students for the technological world.

In recent years, there has also been an increasing demand to

provide better salaries for public school teachers. An example of this was the united front movement by Utah school teachers, who, with the cooperation of the Utah Education Association, refused to sign new contracts for the school year 1964-1965 until some provision for better salaries was provided. As a result, the legislative body of the state of Utah did appropriate more money for higher teacher salaries. There was, however, much public opposition and resentment because of the higher salaries. Some citizens expressed their views in the local newspapers. The following are two such expressions: Ward (1963, p.20A) stated, "I know many people who could not make the grade in the school of engineering or law who studied education and became 'A' students." M.H. (1964, p.16A) stated, " . . . taught by cross, overwhelmed, inadequately prepared teachers."

In view of some of the above statements, the new curriculum programs, and the demand for better qualified teachers, the researcher felt that there was a need for research in mathematics teacher preparation.

At the present time, it is unknown to what extent the secondary public school mathematics teachers in the state of Utah are academically trained in mathematics. Since leaving the mathematics teaching profession to work for the government, the researcher has found a large number of people who have the conception, right or wrong, that most secondary school teachers have very limited academic mathematics training. The purpose of this study is to determine the mathematics training of public secondary mathematics teachers in Utah, and to compare this with the recommendations for the training

of secondary mathematics teachers made by such groups as the Committee on the Undergraduate Program in Mathematics (CUPM) and the American Association for the Advancement of Science (AAAS).

## REVIEW OF THE LITERATURE

### A look at secondary school mathematics

Ricks (1964, p.248) recorded that Francis Keppel, U. S. Commissioner of Education, stated, "The real issue is not whether our students are better than those of a generation ago, but whether the quality of today's education is sufficient to meet tomorrow's demands, which will be infinitely more complex than those of the past or the present."

Many prominent educators, scientists, professional people, and members of academic organizations are concerned about the quality of mathematics preparation that today's secondary school student receives. Many believe that the students do not have properly trained and qualified mathematics instructors.

Bell (1963) stressed the importance of mathematics in all fields, not just in engineering, physical science, and the mathematics teacher training of teachers. Colleges are now including requirements for additional training in mathematics in the fields of economics, sociology, psychology, business, and almost all of the vocational fields. Even with the additional requirements in mathematics training, Conant (1963) reported that mathematics is in a less favorable position than any other science, except physics, with respect to the percentage of classes taught by inadequately prepared teachers. Conant (1963) also reported that, for mathematics teachers of grades nine through twelve, eleven percent had less than nine semester hours of mathematics, twelve percent had from nine to seventeen semester hours,

thirty-two percent had from eighteen to twenty-nine semester hours, and forty-five percent had more than thirty semester hours. For mathematics teachers of grades seven and eight, thirty-four percent had less than nine semester hours, nineteen percent had from nine to seventeen semester hours, twenty-six percent had from eighteen to twenty-nine semester hours, and twenty-one percent had over thirty semester hours in mathematics.

According to a study by Obourn, Ellsworth, and Brown (1963) approximately 120,000, or twenty percent, of the public secondary school teachers teach mathematics. In the fall of 1961, only thirteen percent of these teachers were teaching four or more classes in mathematics each day. One-seventh of the mathematics teachers were teaching only one mathematics class, and these teachers, in general, were inadequately prepared. Obourn and his associates (1963) stated that the national-average size for a mathematics class in 1961 was twenty-seven students. On this basis approximately 17,000 teachers, many of whom were given misassignments and were poorly prepared in mathematics, influenced approximately 459,000 pupils at a time when they needed good mathematics instruction.

Carleton (1965) reported that there were 161,000 secondary mathematics teachers in 1965. If one-seventh of these teachers teach only one class of mathematics per day and are mathematically unprepared, and if the average number of pupils is still twenty-seven, then 621,000 students could have been adversely influenced toward mathematics. If such statistics are accurate, then certainly

something needs to be done about the teacher preparation and the quality of mathematics instruction received by many of today's students.

Schumaker (1961) has given us a comparison of the median-minimum requirement for a mathematics teaching major and minor for the years 1920-1921 and 1957-1958. In 1920-1921, the major was twenty-four and the minor was twelve semester hours. In 1957-1958, the major was twenty-eight and the minor was eighteen semester hours. Brown and Obourn (1959) examined the transcripts of 799 mathematics teachers in Maryland, New Jersey, and Virginia, and found that 7.1 percent had no preparation in college mathematics, and that most of them taught general mathematics. The average number of mathematics semester hours was from seventeen to twenty-three. Sixty-one percent of the teachers who were studied had taken courses in calculus and beyond.

Estes (1961) reports that Burger (1959) concluded a study on academic preparation of 1,037 public high school mathematics teachers in the state of Kansas for the year 1957-1958, and found that thirty-three percent had majors in mathematics, with at least twenty-four semester hours in mathematics. Fifty percent had less than twenty-one hours of preparation, forty-two percent had completed calculus, and twenty-eight percent had taken over twenty-eight semester hours of mathematics. In these studies, there has not been a substantial increase in the mathematics preparation of teachers since 1927.

As further evidence of the lull in mathematics teacher standards, Brickman (1962) revealed that of 190 new mathematics teachers

in Virginia in 1959-1960, only seventy-two percent had as many as twelve college semester hours in mathematics. Brickman (1962, p.27) stated, "It is not enough to love children, to have the proper attitude, and to have good intentions in the professional work of teaching. Ignorance encourages and gives birth to more ignorance. 'As is the teacher, so is the school' and so are most of the pupils."

A survey of fifty randomly selected public secondary schools in Missouri was conducted by Alspaugh (1966) to determine the scope of the mathematics preparation of the secondary school mathematics teachers through institutes, undergraduate work, graduate work and methods courses in the teaching of secondary school mathematics. His results showed that all teachers in the sample had a bachelor's degree, and that twenty-eight percent had a master's degree. Sixty-three percent had attended some type of institute for mathematics teachers, and the average number of mathematics semester hours was 32.8.

Alspaugh's findings were considerably better than Pruitt's (1961). Pruitt conducted a study on mathematics teachers who had been teachers less than eight years to determine mathematical preparation in college mathematics. In Pruitt's study, less than one-third of the mathematics teachers in grades seven and eight had the equivalent of a major in mathematics, or forty-five quarter hours. Twenty percent had less than twenty-seven quarter hours, and five percent had not earned a single credit hour in college mathematics. Alspaugh's study indicates, since it was done more recently, that conditions are improving and that teacher preparation

is getting better.

#### Reasons for teacher unpreparedness

McAulay (1965) indicated, the greatest weakness in the secondary school is the shortage of qualified science and mathematics teachers. Fourteen thousand American high schools have no trained physics teachers. Many of the best science and mathematics teachers are enticed away by industry and government. Therefore, school administrators are forced to employ teachers who have science and mathematics as their second or third teaching area. These teachers prepare lessons in subjects in which their background is weak, and the frustrations thus generated are quickly passed on to their students. The chief result is that little interest is created in science and mathematics.

Gourley and Pourchot (1965) did a study on teacher dropouts and found that fifty percent of the teacher dropouts gave "insufficient salary" as the reason for dropping out. A comparison of lifetime earnings of male high school teachers to male high school graduates as reported in the U. S. Bureau of Labor Statistics suggests one reason why the better prepared mathematics teachers might leave the profession. The statistics show that the estimated lifetime earnings of all men in the United States with only a high school education are nine percent higher than the lifetime earnings of male high school teachers with four years of college preparation.

Carleton (1965) indicated that teaching of mathematics at the secondary school level is "men's work" by a ratio of nearly five to three. With such a low lifetime earning possibility, the better mathematics students may take a few more semesters or quarters of mathematics and



go into the scientific fields rather than the teaching profession. Indications of this are brought out by Bryant et al (1963) and by Maul (1966). Bryant and his associates, in their study of mathematics teaching majors at the University of California, found that widespread competition from industry and government has made it extremely difficult to find good teacher candidates, and that in six years only thirteen graduates in mathematics have become secondary school teachers. Maul's research shows that for every mathematics teacher vacancy in the secondary schools, the number of graduates per vacancy in the United States is .59, and in Utah .65. This ratio of graduates per vacancy was the smallest of fourteen major fields. Many of the mathematics teacher graduates do not enter the teaching profession, therefore, these statistics should indicate the alarming and critical status of the mathematics teacher supply and should be some indication of why teachers are sometimes given misassignments in mathematics.

Ford and Allen (1966) in their report on the recent survey taken by the Special Committee on the Assignment of Teachers, appointed by the National Commission on Teacher Education and Professional Standards, indicate that misassignment is a serious problem. The survey shows that of those given misassignments, fifty-nine percent did not have subject matter competence appropriate to the grade level and/or subject taught. The subjects in which secondary school misassignments occur most often are the sciences. Viall (1962) also reported that thirty percent of all science and mathematics classes in the American secondary schools are taught by teachers who spend some or most of their time teaching outside

these fields.

### Recommendations for mathematics teacher curriculum

Of the several professional committees and individuals who have made recommendations for secondary mathematics teacher programs, perhaps the most widely known is the Committee on the Undergraduate Program in Mathematics (CUPM). The CUPM is a committee of the Mathematics Association of America, and is supported in part by the National Science Foundation. The general purpose of this committee is to develop a broad program of improvements for the undergraduate mathematics curriculum of the nation's colleges and universities. The CUPM (1960) report made the recommendation that there be five levels of preparation. The levels are: (1) Teachers of elementary school mathematics, (2) Teachers of the elements of algebra and geometry, (3) Teachers of high school mathematics, (4) Teachers of the elements of calculus, linear algebra, probability, etc., and (5) Teachers of college mathematics.

The secondary schools are concerned particularly with levels two and three. The following are their recommendations for these two levels.

Level 2. Prospective teachers of the elements of algebra and geometry should enter this program ready for a mathematics course at the level of a beginning course in analytical geometry and calculus. It is recognized that many students will have to correct high school deficiencies in college. (However, such courses as trigonometry and college algebra should not count toward the fulfillment of minimum requirements at the college level.) Their college mathematics training should include: (A) Three courses in elementary analysis. This introduction to analysis should stress basic concepts. However, prospective teachers should be qualified to take more advanced

mathematics courses. A year of calculus is required.

(B) Four other courses including a course in abstract algebra, a course in geometry, a course in probability from a set theoretic point of view, and one elective.

Level 3. Prospective teachers of high school mathematics beyond the elements of algebra and geometry should complete a major in mathematics and a minor in some field in which a substantial amount of mathematics is used. The major in mathematics should include, in addition to the work listed under level two, at least an additional course in each of algebra, geometry, and probability-statistics, together with two electives. Thus the minimum requirements for high school mathematics teachers should consist of the following: (A) Three courses in analysis, (B) Two courses in abstract algebra, (C) Two courses in geometry beyond analytical geometry, (D) Two courses in probability and statistics, and (E) Two upper class elective courses. (CUPM, 1960, p.986-987)

The American Association for the Advancement of Science (AAAS) through its cooperative committee on the teaching of science and mathematics, as reported by its chairman, Garrett (1959, 1961), recommended that one-half of the credits earned in satisfying the requirements for the bachelors degree be earned in the subject matter area which the candidate expects to teach. The program should include: (A) Twelve semester hours in analysis including trigonometry, college algebra, analytical geometry, and six hours of calculus, (B) Three semester hours in abstract algebra, matrices, theory of equations, and number theory, (C) Three semester hours in geometry, topology, non-euclidean geometry, and differential equations, (D) Six semester hours in the foundations of mathematics, theory of sets, logic, history of mathematics, postulates of geometry and algebra, and probability and statistics, (E) Three semester hours in applications, mechanics, mathematical physics, actuarial mathematics, numerical analysis, and econometrics, and

(F) Three semester hours in probability and statistics for a total of thirty semester hours plus one years course in physics. The committee also recommends a fifth year with one-half of the work in science.

Dutton (1966) indicated that, with the widespread acceptance of the so called "modern" mathematics, mathematics teachers will need training in the "modern" mathematics characterized by emphasis on mathematical structure and set theoretical language as described in the recent publications.

In Utah, anywhere from 183 to 192 quarter hours are required, depending upon which university one attends, to obtain a bachelors degree. The AAAS committee recommendations would require from ninety-two to ninety-six quarter hours in the subject matter areas which the candidate expects to teach.

Conant (1963) recommends a program of general education including six hours of mathematics, twelve hours of science, and three hours of general psychology for a total of sixty hours. Conant also recommends three hours of educational psychology, three hours of philosophy or history of education, six hours of physics or chemistry, thirty-nine hours of mathematics, and nine hours in practice teaching for a total of 120 semester hours. Conant strongly suggests that an institution award a teaching certificate for teachers in grades seven to twelve in one field only.

#### National Science Foundation scholarships

Through the National Science Foundation, it is hoped that teachers who are unprepared will obtain scholarships to better

prepare and improve their mathematics qualifications. However, such is not always the case. Orr and Young (1963), in their study of who attends NSF institutes, found that many are repeaters and that fifty-five percent of the mathematics and science teachers never apply. Orr and Young's study indicated that those who do not apply are mostly those teachers who need the additional training.

#### Teacher certification and college curriculums

It is evident that the different recommendations for mathematics teacher training have had some effect on the university curriculum, especially in Utah, and also upon state certification requirements for mathematics teachers.

Sarner and Frymier (1959), in their study of certification requirements in mathematics and science, discovered that forty-two states require a baccalaureate degree. One state requires an additional year, and the remaining states demand a lesser amount of training. The semester hours in mathematics required range from zero to twenty-four, the mode being eighteen and the mean fifteen.

The Utah State Department of Education, as stated by Woellner and Wood (1964), requires thirty quarter hours for a mathematics major with fifteen upper division credits, and eighteen quarter hours for a mathematics minor.

Conant (1963) stated that the existing teacher education programs vary from twenty-five to forty semester hours for a mathematics major, and from fifteen to twenty-four semester hours

for a mathematics minor. Smith (1963), in a survey of 213 colleges and universities, found that the percent of institutions requiring a specified number of semester hours (H) beyond calculus to be  $0 \leq H \leq 3$ , 6%;  $3 < H \leq 6$ , 10%;  $6 < H \leq 9$ , 18%;  $9 < H \leq 12$ , 29%;  $12 < H \leq 15$ , 11%;  $15 < H \leq 18$ , 14%;  $18 < H \leq 21$ , 9%; and  $21 < H$ , 3%.

The following is a listing of the requirements for the four largest universities and colleges in the state of Utah for secondary teacher mathematics preparation.

#### Utah State University (1966-67)

Major 29 quarter hours\*

Minor 17 quarter hours

Classes Integral Calculus  
Modern Geometry  
Mathematics for Secondary School Teachers  
Teaching of Mathematics in the Secondary School  
+ 9 upper division credits  
\*College algebra, trigonometry, analytical geometry, and differential calculus are required, but do not count toward the major requirements.

#### University of Utah (1966-67)

Major 45 quarter hours

Minor 29 quarter hours

Classes College Algebra  
Analytical Geometry  
Calculus  
Teaching Secondary Mathematics  
Foundations of Algebra  
Foundations of Geometry  
+ 12 upper division credits

## Brigham Young University (1966-67)

Major 34 semester hours\*

Minor 19 semester hours

Classes Analytical Geometry  
 Calculus  
 History of Mathematics  
 Theory of Numbers  
 Foundations of Algebra  
 Modern Algebra  
 Probability  
 + 9 upper division credits  
 \*College algebra and trigonometry are  
 required, but do not count toward the  
 major requirements.

## Weber State College (1966-67)

Major 42 quarter hours

Minor 26 quarter hours

Classes College Algebra  
 Analytical Geometry  
 Calculus  
 Modern Algebra  
 Foundations of Geometry  
 Teaching Secondary School Mathematics  
 + 13 upper division credits  
 + 10 credits in physics or chemistry

It is possible to readily recognize the CUPM's recommendations, as well as recommendations from other committees and individuals, in the requirements and classes of the Utah universities and colleges. The certification requirements of the state of Utah, however, are far below the college and university requirements.

Summary of the review

It is evident from the review that mathematics teacher preparation has been improved and influenced by the different committees and individual recommendations. There is also much evidence that the

nation is lacking in qualified mathematics teachers, and that many students are being taught by unprepared mathematics teachers. This could be one of the reasons that Howe (1966) indicated that the learning of mathematics seems to be more productive in other countries than in the United States.



## PROCEDURES

### Selection of surveyed schools

A list of all secondary schools in Utah was obtained from the Utah State Department of Education. The list indicated that there are 85 public high schools, 38 class A and 47 class B; and 84 public junior high schools.

Since there was approximately an equal number of high schools and junior high schools, one-half of the two types of public secondary schools were surveyed.

In order to select the schools through random sampling, each high school and each junior high school was assigned a two digit number. Using the Chemical Rubber Company (1961) random units table, 43 high schools were selected; 22 class A and 21 class B. Using the same type of procedure, 42 junior high schools were selected. Table 1 contains a list of the selected schools.

### Identifying mathematics teachers

To obtain an accurate list of the teachers who teach any mathematics class in the selected schools, a letter (Appendix letter 1) was sent to the principal of each selected school requesting a teacher class schedule of the teachers in his school. If a principal did not reply, a second request (Appendix letter 2) was sent to him.

Table 2 gives the percentage of teacher schedules returned by the principals.

Table 1. Selected secondary schools

Class A	Class B	Jr. High School
Bear River	Beaver	American Fork
Bountiful	Bryce Valley	Bear River
Carbon	Cedar City	Box Elder
Clearfield	Duchesne	Brockbank
Davis	Dugway	Bryant
Granger	Enterprise	Centerville
Hillcrest	Grand	Central (Ogden)
Jordan	Grantsville	Central (Davis)
Kearns	Green River	Dixon
Lehi	Hurricane	Evergreen
Logan	Milford	Grand
Murray	Millard	Granite Park
Olympus	Monticello	Helper
Orem	Morgan	Hillside
Pleasant Grove	North Rich	Horace Mann
Roy	North Sanpete	Irving
Skyline	Park City	Jackson
Sky View	Parowan	Jordan
Spanish Fork	South Rich	Kaysville
Tooele	Valley	Lewiston
Weber	Wayne	Midvale
West		Mound Fort
		Mount Jordan
		Mount Ogden
		North Sanpete
		Pleasant Grove
		Richfield
		Roosevelt (Duchesne)
		Roy
		South
		South Emery
		Spanish Fork
		Springville
		T.H. Bell
		Tooele
		Valley (Granite)
		Valley (Weber)
		Wasatch
		Washington
		Wellington
		West
		West Jordan

Table 2. Percent of school teacher class schedules returned

Type of School	Selected	Replied	Percent
Class A	22	19	86.36
Class B	21	19	90.48
Jr. High School	<u>42</u>	<u>39</u>	<u>92.86</u>
Total	85	77	90.59

From the individual school teaching schedules, it was possible to obtain the mathematics teachers' names, as well as the number and type of mathematics classes that each teacher teaches per day.

To obtain the individual teacher information on academic preparation, a letter and a questionnaire (Appendix letter 3 and questionnaire) was sent to every mathematics teacher in the selected schools. If a teacher did not respond with the specified time limit a second letter (Appendix letter 4) with an accompanying questionnaire was sent to him. Table 3 gives an analysis of the teacher questionnaire response.

Table 3. Teacher questionnaire response

Type of School	Sent	Returned	Percent
Class A	127	122	96.06
Class B	66	59	89.39
Jr. High School	<u>185</u>	<u>164</u>	<u>88.65</u>
Total	378	345	91.27

## RESULTS AND DISCUSSION

Utah's secondary mathematics teachers and the AAAS recommendations

The AAAS recommends that a mathematics teaching major should have at least 45 quarter hours in mathematics. Included in the AAAS course recommendations are trigonometry and college algebra. The CUPM course recommendations does not include trigonometry and college algebra, they are listed as prerequisite or remedial classes. The teacher questionnaire did include these two classes, as well as a remedial class, intermediate algebra, because they are accepted by the Utah State Department of Education.

Table 4 shows the percentage of teachers in the surveyed Utah public secondary schools who teach any mathematics class and, according to their questionnaire response, meet the AAAS requirements.

Table 4. Surveyed mathematics teachers who meet the AAAS requirements

Type of School	Number of Teachers	Teachers with Mathematics Credit $\geq 45$	Percent
Class A	122	62	50.82
Class B	59	8	13.56
Jr. High School	164	45	27.24
Total	345	115	33.33

Since table 4 includes all teachers of mathematics regardless

of the number of mathematics classes per day that they teach, a more accurate picture was obtained by looking only at those teachers who teach three or more mathematics classes per day. Table 5 gives this comparison.

Table 5. Surveyed mathematics teachers of three or more mathematics classes per day who meet the AAAS requirements.

Type of School	Number of Teachers	Teachers with Mathematics Credit $\geq 45$	Percent
Class A	94	59	62.77
Class B	32	6	18.75
Jr. High School	125	44	35.20
Total	251	109	43.43

From tables 4 and 5, it is obvious that more than half of Utah's public secondary mathematics teachers do not meet the AAAS recommendations. Particularly alarming is the situation of the class B high school mathematics teachers. Only 8 out of 59, or 13.56 percent, of the surveyed class B mathematics teachers met the AAAS requirements. Out of the 32 surveyed class B mathematics teachers of three or more mathematics classes per day, only 6, or 18.75 percent, met the AAAS requirements.

#### Teachers with fifteen or less quarter hours in mathematics

Since the teachers' response showed that 56.57 percent of the public secondary mathematics teachers do not meet the suggested AAAS and CUPM

requirements, it was proposed to find out how many or what percent had fifteen or less quarter hours of academic credit in mathematics. Table 6 gives this information for all surveyed mathematics teachers, while Table 7 includes only teachers of three or more mathematics classes per day. Both tables are divided into four distinct groups: (1) 0 hours, (2) 1 to 7.5 hours, (3) 7.5 to 15 hours, and (4) an over-all sum combining from 0 to 15 quarter hours.

Basically, intermediate algebra, college algebra, and trigonometry are the courses completed by most of the teachers having only up to fifteen quarter hours in mathematics.

Table 6. The number and percent of teachers having X quarter hours in mathematics.

Type of School	Number Surveyed Teachers	Number with X=0	%	Number with $1 \leq X \leq 7.5$	%	Number with $7.5 < X \leq 15$	%	Number with $0 \leq X \leq 15$	%
Class A	122	2	1.64	4	3.29	9	7.38	15	12.30
Class B	59	2	3.39	10	16.95	14	23.73	26	44.08
Jr. H. S.	164	14	8.54	14	8.54	25	15.24	53	32.32
Total	345	18	5.22	28	8.12	48	13.91	94	27.25

Tables 6 and 7 point out again the unqualified status of the class B high schools. There were 44.08 percent of all teachers of mathematics in class B schools and 18.75 percent of their teachers of three or more classes of mathematics per day with zero to fifteen quarter hours in mathematics.

Table 7. The number and percent of teachers of three or more mathematics classes per day having X quarter hours in mathematics.

Type of School	Number Surveyed Teachers	Number with X=0	%	Number with $1 \leq X \leq 7.5$	%	Number with $7.5 < X \leq 15$	%	Number with $0 \leq X \leq 15$	%
Class A	94	0	0.00	1	1.06	3	3.19	4	4.26
Class B	32	0	0.00	1	3.13	5	15.63	6	18.75
Jr. H.S.	<u>125</u>	<u>3</u>	<u>2.40</u>	<u>5</u>	<u>4.00</u>	<u>16</u>	<u>12.80</u>	<u>24</u>	<u>19.20</u>
Total	251	3	1.20	7	2.79	24	9.56	34	13.54

The questionnaire response, in table 6, shows that 22.03 percent of the teachers of mathematics have from one to fifteen quarter hours, while 5.22 percent have zero hours in mathematics. This is a disturbing total of 27.25 percent of all the surveyed mathematics teachers.

Figure 1 shows the academic preparation of mathematics teachers in the three types of secondary schools. Figure 2 shows the academic preparation of mathematics teachers of three or more mathematics classes per day in the three types of secondary public schools.

#### Students affected by unprepared teachers

In the class B high schools, almost without exception, all of the above mentioned teachers of low mathematics credit teach junior high school or general mathematics. However, there were several class B high schools that didn't have a mathematics teacher with more than fifteen quarter hours of mathematics preparation. In the class A high schools, the aforementioned teachers of low mathematics credit generally teach general or basic mathematics. It is interesting

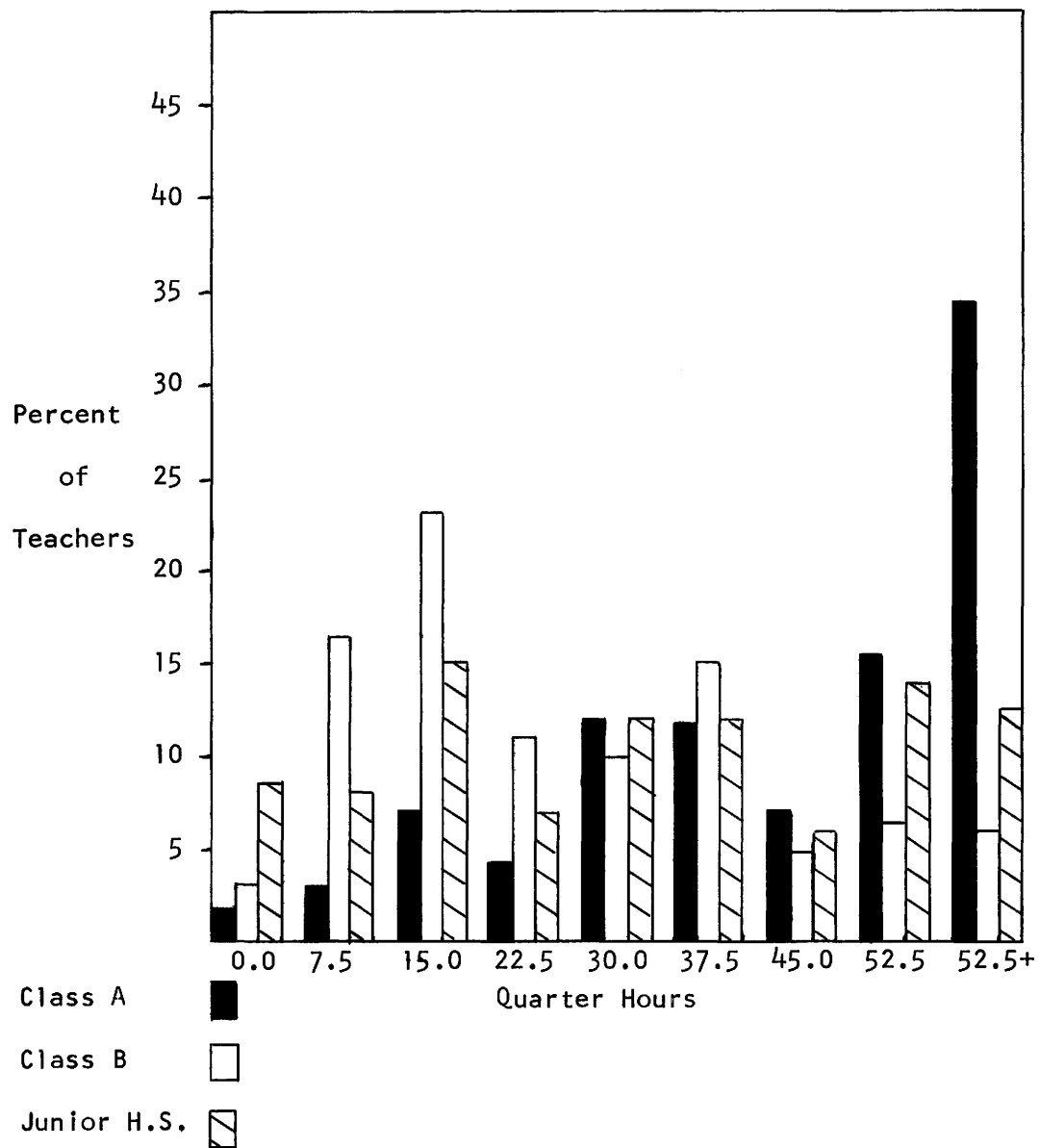


Figure 1. College mathematics credit of all surveyed teachers.



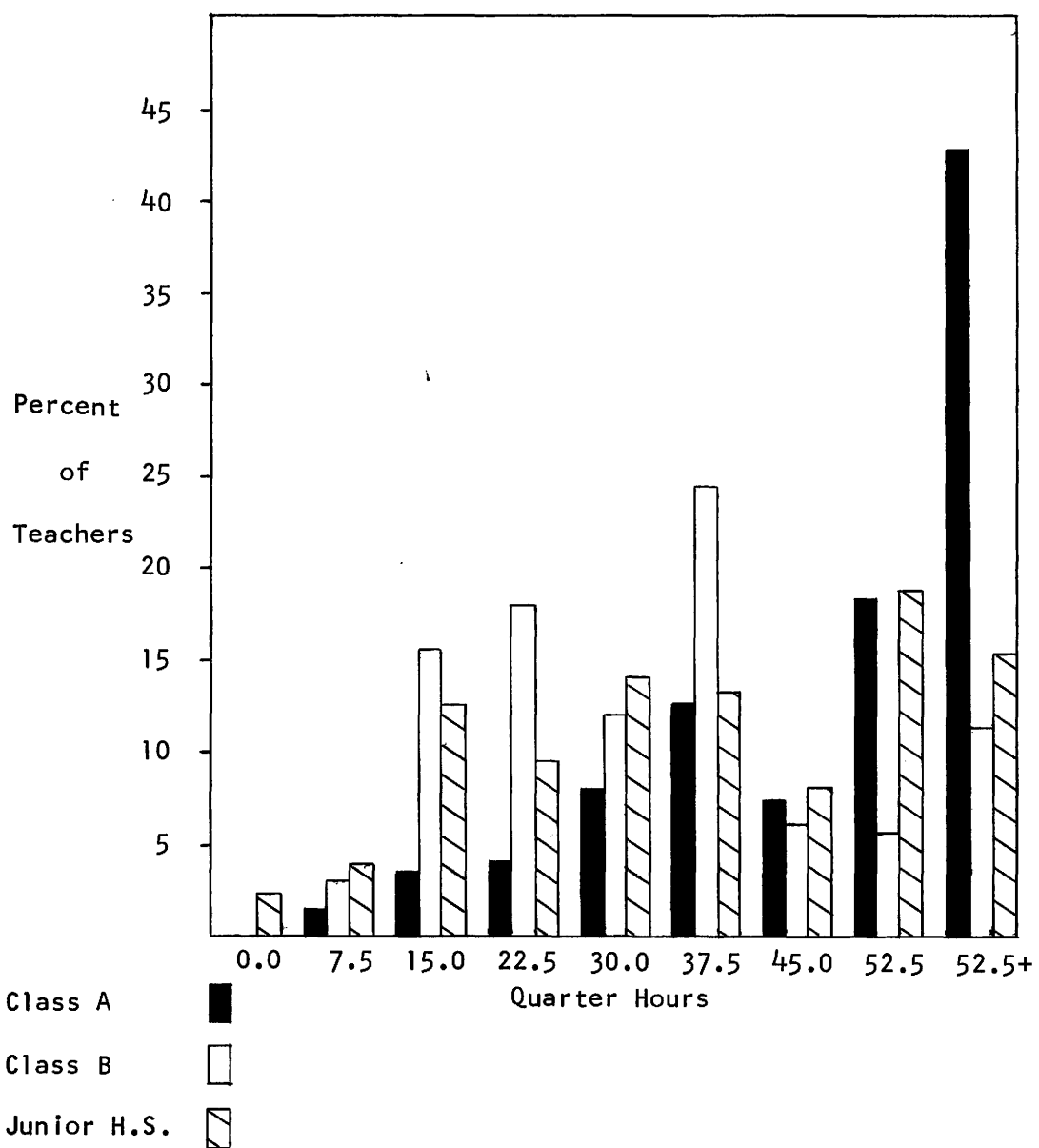


Figure 2. College mathematics credit of surveyed teachers of three or more mathematics classes per day.

to note that the Northwest certification requirements state that mathematics teachers must have 24 quarter hours of college mathematics, and general mathematics teachers must have only 9 quarter hours of college mathematics.

The questionnaires and teaching schedules showed that the 94 teachers having zero to fifteen quarter hours in mathematics teach 235 classes of mathematics per day. If the average number of students per class is still the national average of 1961, or 27, then 8,343 pupils were affected by these teachers each day.

Out of the 169 public secondary schools in Utah a survey from 77, or 45.56 percent, were actually received. If the random sample is typical of the public secondary schools in Utah, then approximately 17,000 students per day were in classes with teachers who have fifteen or fewer quarter credits of college mathematics.

Perhaps this is one reason why the United States had such a poor showing in the mathematics study conducted by the International Project for the Evaluation of Educational Achievement with the help of UNESCO. Dr. Jerrold Zacharias (1967), Massachusetts Institute of Technology's curriculum reformer, was quoted in Time magazine to have said, "Americans have mathophobia," they are "scared to death of mathematics because most teachers are afraid of it themselves and fail to make it exciting."

#### Comments from some of the misassigned surveyed teachers

Several of the surveyed teachers who were misassigned made voluntary comments on their questionnaires as to why they were teaching mathematics (see Appendix).

The most common reason given was that their school had mathematics classes scheduled and didn't have enough mathematics teachers available to teach the classes. Therefore, other teachers were appointed or elected by the school administration to teach the leftover mathematics classes.

#### One year of calculus

Both the AAAS and the CUPM committees recommend one year of calculus for all secondary mathematics teachers. Table 8 shows the number and percent of surveyed secondary mathematics teachers who have completed one year of calculus. Table 9 shows the same information but only for teachers of three or more mathematics classes per day.

Table 8. Mathematics teachers who have completed one year of calculus.

Type of School	Teachers	Completed	Percent
Class A	122	81	66.39
Class B	59	25	42.37
Jr. High School	<u>164</u>	<u>78</u>	<u>47.56</u>
Total	345	184	53.33

#### Modern mathematics and NSF institutes

Since almost all of the new mathematics text books, as well as the NSF mathematics institutes, include the so-called "modern" mathematics, the questionnaire asked if the teacher had completed any formal

modern mathematics training. Table 10 shows the teachers response.

The questionnaire also asked if the teacher had attended a NSF mathematics institute. The questionnaire did not stipulate whether the institute was in-service, summer, or academic year. Table 11 shows their response.

Table 9. Mathematics teachers of three or more classes per day who have completed one year of calculus.

Type of School	Teachers	Completed	Percent
Class A	94	75	79.79
Class B	32	17	53.13
Jr. High School	<u>125</u>	<u>73</u>	<u>58.40</u>
Total	251	165	65.74

Table 10. Formal training in modern mathematics.

Type of School	Teachers	Completed	Percent
Class A	122	90	73.77
Class B	59	30	50.85
Jr. High School	<u>164</u>	<u>116</u>	<u>70.73</u>
Total	345	236	68.73

Table 11. National Science Foundation mathematics institute participation.

Type of School	Teachers	Attended	Percent
Class A	122	65	53.28
Class B	59	16	27.11
Jr. High School	<u>164</u>	<u>70</u>	<u>42.68</u>
Total	345	151	43.77

### SUMMARY

The concept that there is equal educational opportunity for all students in the state of Utah is obviously incorrect. It appears, from the teachers' response, that the larger school districts, or class A high schools, have better academically prepared teachers. The class A schools offer a wider mathematics curriculum and provide better prepared mathematics teachers.

It was noted that 5.2 percent of the secondary mathematics teachers have no college mathematics preparation and that 27.25 percent have 0 to 15 quarter hours of college mathematics preparation.

There is a smaller percentage of well prepared mathematics teachers in the class B high schools than in either the class A high schools or the junior high schools. There were 62.77 percent of the mathematics teachers in the class A high schools, 35.20 percent of the mathematics teachers in the junior high schools, and only 18.75 percent of the mathematics teachers in the class B high schools with 45 or more quarter hours of college mathematics preparation.

The National Science Foundation has helped tremendously in better preparing today's mathematics teachers. The survey indicated that 43.77 percent of the states secondary mathematics teachers have participated in some type of NSF institute.

There seems to exist a definite need to improve the mathe-

matics preparation of the secondary mathematics teacher in the state of Utah.

## RECOMMENDATIONS

### Consolidation of small schools

The consolidation of small schools would undoubtedly help eliminate part of the poor showing of the class B high schools. The consolidated new school could offer a better and broader curriculum and, it is hoped, obtain better prepared mathematics teachers.

### Increased salary

McAulay (1965) suggested one means of obtaining and retaining well qualified mathematics teachers. His suggestion was to pay extra monetary consideration above those of the average classroom teacher. He stated that coaches and some music teachers have long received this compensation.

If a mathematics teaching major has completed the suggested curriculum of one of the four largest colleges in the state of Utah he can qualify as a GS-5 mathematician under the Civil Service Announcement No. DE-6(1964). If the graduate has a grade point average of 3.0 or above then he can qualify as a GS-7 mathematician. The Civil Service mathematicians annual salary at present is: GS-5, \$6,387.00; GS-7, \$7,729.00; GS-9, \$9,001.00; and GS-11, \$10,481.00. The time between these GS mathematicians grades is usually one year. It is obvious to see that in four years it is possible to have an annual salary of over \$10,000.00. In education a mathematics teacher could be teaching for twenty-five years, at



the present salary schedules, and still never receive \$10,000.00 per annum. To a new college graduate or to a graduate with a young family the higher salary is very enticing. As a result, many of the better prepared mathematics teachers are lured from a career in mathematics education.

#### Continuing education

Delessert (1966) suggested that every secondary school district organize, under the direction of a college or university, a weekly or semi-monthly seminar in which all who teach mathematics would participate. The district could then strongly encourage teachers to continue studying mathematics, after obtaining their degrees, by providing time and money for the continuing education of in-service teachers.

#### Teacher certification

According to the National Education Associations National Committee on Teacher Education and Professional Standards (NCTEPS) (1961), 41 states issue endorsed teaching certificates, which means that one or more teaching fields or subjects for which the holder meets the specified preparation requirements of the state are endorsed on the certificate. Thirty-two states reported that the enforcement of teaching assignments (according to qualifications of the teachers who meet the state requirements) is based on the type of certificate held and the endorsed qualifications thereon.

Woellner and Wood (1965) in their "Requirements for Certification" state that Utah still issues a general secondary teach-

ing certificate.

Certainly an endorsed teaching certificate, or a teaching certificate issued for specific subjects, would help eliminate the misassignment of many teachers.

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**APPEND IX**

2928 Grant Avenue  
Ogden, Utah  
February 14, 1967

Mr. Donald Wright, Principal  
Bountiful High School  
Bountiful, Utah 84010

Dear Mr. Wright:

As part of the requirements for a Masters of Science degree in Secondary Education at Utah State University, I am doing a research study on teacher personnel in the Utah public secondary schools.

Your school has been chosen through a random selection as one of the 88 junior and senior high schools to be studied.

Would you please send by February 23, 1967, using the return addressed stamped envelope, a teaching schedule of the teachers in your school.

I am sure that you realize that without your response the result will be a biased survey and study. Your reply will contribute significantly toward realizing and solving some of the problems in education today. Thank you.

Sincerely,

Charles M. Crittenden

enc

2928 Grant Ave.  
Ogden, Utah 84401  
February 28, 1967

Mr. Ernest A. Pizza, Principal  
Skyline High School  
3251 E. 3760 S.  
Salt Lake City, Utah 84109

Dear Mr. Pizza:

In order to complete my Masters degree at Utah State University, I am doing a survey on public secondary school personnel.

I am sure that, due to an error on my part or some oversight, my previous request has been overlooked or lost.

I am particularly desirous of obtaining your response because it will give me a more accurate picture of the teaching schedules in our state.

It will be appreciated if you will return in the enclosed stamped addressed envelope a copy of the teaching schedule of the teachers in your school.

Thank you for your cooperation.

Sincerely,

C. M. Crittenden

enc



2928 Grant Ave  
Ogden, Utah  
March 2, 1967

Mr. Butcher  
Grantsville High School  
Grantsville, Utah

Dear Mr. Butcher:

The attached questionnaire concerned with secondary mathematics teacher preparation is part of a state-wide study being carried on through the Utah State University. This project is concerned specifically with determining the present academic training of the mathematics teachers in our state.

We are particularly desirous of obtaining your response because your teaching experience and background will contribute significantly toward solving some of the problems we face in this important area of education.

The enclosed questionnaire has been tested with a sampling of mathematics teachers, and we have revised it in order to make it possible for us to obtain all necessary data while requiring a minimum of your time. The average time required for teachers trying out the questionnaire was five minutes.

It will be appreciated if you will complete the questionnaire prior to March 7, 1967, and return it in the enclosed stamped addressed envelope. Other phases of this research cannot be carried out until we complete the analysis of the questionnaire data.

We would welcome any comments that you may have concerning any aspect of mathematics teachers preparation not covered in the questionnaire. Thank you for your cooperation.

Sincerely,

Charles M. Crittenden

enc

2928 Grant Ave  
Ogden, Utah  
March 10, 1967

Mr. Butcher  
Grantsville High School  
Grantsville, Utah

Dear Mr. Butcher:

Attached is a questionnaire concerned with secondary mathematics teacher preparation which is part of a statewide study being carried on through the Utah State University.

We are sure that, due to an error on our part or some oversight, your previous questionnaire has been overlooked or lost.

We are particularly desirous of obtaining your response because of your mathematics teaching experience and background. We feel that your response can help in developing a better secondary mathematics teacher program.

It will be appreciated if you will complete the questionnaire prior to March 17, 1967, and return it in the enclosed stamped addressed envelope.

Thank you for your cooperation.

Sincerely,

Charles M. Crittenden

enc

## QUESTIONNAIRE

1. What educational level do you teach? (check the appropriate answer)
  - a. \_\_\_\_\_ Jr. High School
  - b. \_\_\_\_\_ Sr. High School
  - c. \_\_\_\_\_ Both Jr. and Sr. High School
2. How many classes of mathematics per day do you teach? (check the appropriate answer)
  - a. \_\_\_\_\_ one
  - b. \_\_\_\_\_ two
  - c. \_\_\_\_\_ three
  - d. \_\_\_\_\_ four
  - e. \_\_\_\_\_ five
  - f. \_\_\_\_\_ six
3. What is your main mathematics teaching assignment? (check the appropriate answers)
  - a. \_\_\_\_\_ Jr. High School
  - b. \_\_\_\_\_ General Math or Business Math
  - c. \_\_\_\_\_ First year algebra or geometry
  - d. \_\_\_\_\_ High School Math (2nd year algebra, trig., etc)
  - e. \_\_\_\_\_ Advance placement (college mathematics)
4. Have you had any college training in the so-called "modern" mathematics?
  - a. \_\_\_\_\_ yes
  - b. \_\_\_\_\_ no

5. Have you participated in a National Science Foundation mathematics institute?
- a. ☐ yes
  - b. ☐ no
6. What is your college teaching major? (check the appropriate answer)
- a. ☐ Biological Science
  - b. ☐ Business or Economics
  - c. ☐ Chemistry
  - d. ☐ Composite Exact Science
  - e. ☐ English or Dramatics
  - f. ☐ History or Political Science
  - g. ☐ Industrial Arts or Agriculture
  - h. ☐ Mathematics
  - i. ☐ Music or Art
  - j. ☐ Physical Education
  - k. ☐ Physics
  - l. ☐ Social Science or Psychology
  - m. ☐ Special Education
  - n. ☐ Other (list) \_\_\_\_\_
7. What is your college teaching minor? (check the appropriate answer)
- a. ☐ Biological Science
  - b. ☐ Business or Economics
  - c. ☐ Chemistry
  - d. ☐ English or Dramatics

- e. \_\_\_\_\_ History or Political Science
- f. \_\_\_\_\_ Industrial Arts or Agriculture
- g. \_\_\_\_\_ Mathematics
- h. \_\_\_\_\_ Music or Art
- i. \_\_\_\_\_ Physical Education
- j. \_\_\_\_\_ Physics
- k. \_\_\_\_\_ Social Science or Psychology
- l. \_\_\_\_\_ Special Education
- m. \_\_\_\_\_ Other (list) \_\_\_\_\_

8. Check the college courses you have completed successfully.

- a. \_\_\_\_\_ Beginning Algebra
- b. \_\_\_\_\_ Intermediate Algebra
- c. \_\_\_\_\_ College Algebra
- d. \_\_\_\_\_ Trigonometry
- e. \_\_\_\_\_ Analytical Geometry
- f. \_\_\_\_\_ Differential Calculus
- g. \_\_\_\_\_ Integral Calculus
- h. \_\_\_\_\_ Differential Equations
- i. \_\_\_\_\_ Modern Algebra
- j. \_\_\_\_\_ Advanced Calculus
- k. \_\_\_\_\_ Number Theory
- l. \_\_\_\_\_ Probability
- m. \_\_\_\_\_ Statistics
- n. \_\_\_\_\_ Matrix Theory
- o. \_\_\_\_\_ Theory of Equations
- p. \_\_\_\_\_ Numerical Analysis

- q. \_\_\_\_\_ Axiomatic Development of Algebra
- r. \_\_\_\_\_ Axiomatic Development of Geometry
- s. \_\_\_\_\_ Topology
- t. \_\_\_\_\_ Teaching Secondary School Mathematics
- u. \_\_\_\_\_ History of Mathematics
- v. \_\_\_\_\_ Other (list) \_\_\_\_\_

9. How many mathematics credits (x) do you have? (check the appropriate answer)

- a. \_\_\_\_\_  $1 < x \leq 5$  sem hrs or  $1 < x \leq 7.5$  qu hrs
- b. \_\_\_\_\_  $5 < x \leq 10$  sem hrs or  $7.5 < x \leq 15$  qu hrs
- c. \_\_\_\_\_  $10 < x \leq 15$  sem hrs or  $15 < x \leq 22.5$  qu hrs
- d. \_\_\_\_\_  $15 < x \leq 20$  sem hrs or  $22.5 < x \leq 30$  qu hrs
- e. \_\_\_\_\_  $20 < x \leq 25$  sem hrs or  $30 < x \leq 37.5$  qu hrs
- f. \_\_\_\_\_  $25 < x \leq 30$  sem hrs or  $37.5 < x \leq 45$  qu hrs
- g. \_\_\_\_\_  $30 < x \leq 35$  sem hrs or  $45 < x \leq 52.5$  qu hrs
- h. \_\_\_\_\_  $35 < x$  sem hrs or  $52.5 < x$  qu hrs

10. From what college or university did you graduate? (list)

\_\_\_\_\_

## TEACHERS COMMENTS

1. "This class I teach was left over and I was elected to teach it. I am not a mathematics teacher."
2. "I don't teach math regularly. I teach math only when I don't have enough business students for a full schedule."
3. "Perhaps a word of explanation as to why I am teaching out of my field may be helpful. I spent one year in elementary education at the Provincial Normal School in Canada before coming to the BYU. Having received credit for the schooling in Canada this took the place of the usual minor I ordinarily would have had to complete.

Each teacher at our school was asked which classes he would like to teach, should it be necessary to teach additional subjects. I asked to teach 7th grade math, knowing that it was an extension of the 6th grade math I had previously taught.

I don't feel qualified to teach math beyond this level without additional special training."

4. "I am not a math teacher. I am only filling in until B. R. Jr. H. S. can get a remedial math teacher.

I am a drama director and I intensely detest having any other course shoved on to me.

Would you people help start a legislative program going to get laws passed to keep administrators from putting teachers

into fields or subjects they are neither qualified or desirous of teaching. In short make it unlawful to put teachers in any field except that which they have qualified to teach in.

Wyoming and several other states have such - they arrange their secondary curriculum to, or else hire teachers to fit their needs.

This would be a step forward in upgrading educational procedure and raise quality standards of educated youngsters in Utah."



## VITA

Charles Martin Crittenden

Candidate for the Degree of

Master of Science

Thesis: The Academic Preparation and Background of Public  
Secondary Mathematics Teachers in Utah 1966-1967

Major Field: Secondary Education (Mathematics)

Biographical Information:

Personal Data: Born at Ogden, Utah, May 20, 1935, son  
of George Carroll and Luella Nicholas Crittenden;  
married Gloria Nadine Dalton September 4, 1959;  
four children--Herbert, Charlene, Lillie Ann, and  
Kristanne.

Education: Attended elementary school in Ogden, Utah;  
graduated from Ogden High School in 1953; received  
the Associate of Science degree from Weber State  
College in 1955; received the Bachelor of Science  
degree from Utah State University, with a major in  
secondary education exact science composite, in  
1962; completed requirements for the Master of  
Science degree, specializing in mathematics education  
and secondary administration, at Utah State University  
in 1968.

Professional Experience: September 1967 to present,  
instructor of computer science, Technical Division,  
Weber State College; 1965-67, scientific computer  
programmer, Hill Air Force Base, Ogden, Utah;  
1961-65, mathematics teacher, Evanston High School,  
Evanston, Wyoming.